
RC-DBM/PCM/NBM

Radio Remote Control Systems



Use and Maintenance Manual



Write the System Number of your Radio Remote Control Equipment here and keep it as a reference for technical support.

Using the radio Control is forbidden for anybody who has not read and fully understood this manual. Special attention should be given to the safety instructions herein contained.

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The technical features of the Radio Control as described in this Manual may be subsequently modified without notice with the sole purpose of improving the equipment to better satisfy the user.

Changes or modifications not expressly approved by TECNORD could voice the user's authority to operate the equipment

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1 SAFETY

1.1 Safety of the Radio Control System

The Radio Control System has been equipped with electronic and mechanical safety devices. Processing control signals sent by other transmitters is impossible as the transmission codes are totally unique for each system.

1.2 Safety Information

The use of the Radio Control applied to any machinery allows the operator greater freedom of movement within the working area, improved handling accuracy whilst improving both the efficiency and the safety of the operator. However, all these benefits do require a certain attention from the operator and the staff in charge of maintenance.

The correct and safe use of the Radio Control requires the operator to visually follow the remote-controlled machine.

It is therefore compulsory that anyone using the transmitting unit stops the Radio Control by pushing the Emergency stop push-button during the break times.

The maintenance staff should check that the receiver unit is not powered during the control operations, the change of the battery or the periodic or extraordinary maintenance operations in general.

Each Radio Control should be checked at least once per year. Any repair should be made at authorized centers or centers that Tecnord has recommended or directly at the Tecnord service and spare parts center. Any use of no-original spare parts or tampering by non-authorized staff immediately cancels all the warranty rights.

1.3 Authorized Operators

IMPORTANT !

Always verify the operating instructions of your machine in order to be aware of any further important information to be observed. When placing the transmitter away during the breaks, the **user must** make sure that no unauthorized people can use it by pushing the Emergency Stop push-button and locking it in a safe place. In this way, any abusive operations by unauthorized third parties will be prevented. The **user must** be able to have access to all of the operating instructions that are necessary for the smooth operation of the machine to be controlled. The user must also read and be sure to have clearly understood each section of this manual before using the Radio Control.

1.4 Safety Measures to be taken within the working area

The user should ensure that the working area in which the Radio Control will be used is free from any risks for the movement or other potential safety risks. For example, the user should verify that the working area is free from any obstacles or dangerous situations that could jeopardize the possibility of operating in total safety.

1.5 Protection Devices

All of Tecnord's industrial Radio Controls have been fitted with an Emergency Stop push-button on the control board of the transmitting unit.

Several other protection devices exist in the Radio Control system which automatically intervene whenever:

- There is a radio interference in the working area that affects the frequency range of the Tecnord Radio Remote Control;
- The action range of the transmitting unit is exceeded.

In the event of the above the Radio Control immediately activates the Emergency Stop, and interrupts any outgoing signal of the receiving unit whilst maintaining, whenever possible, continuous and constant radio contact between the transmitter and receiver.

1.6 How to react and behave in case of an Emergency

WARNING !

In any Emergency situation, immediately push the red EMERGENCY STOP Push-Button (also called: EMERGENCY STOP PUSH). Then, follow the instructions in the machine operating manual.

2 RC-DBX, RC-PCM SYSTEM'S COMPONENTS

A Tecnord's RC-DBX Remote Control System includes the following parts:

- For RC-DBX Systems: SHW TRANSMITTER UNIT (Single Hand Wander, SHW-TX)
- For RC-PCM Systems: PCJ TRANSMITTER UNIT (Shoulder Strap Transmitter, PCJ-TX)
- DBX RECEIVER UNIT (DBX-RX) and Flying Connectors
- BATTERY CHARGE CABLE with plug-in for in vehicle cigarettes-lighter
- BATTERIES (included in the Transmitter Unit)

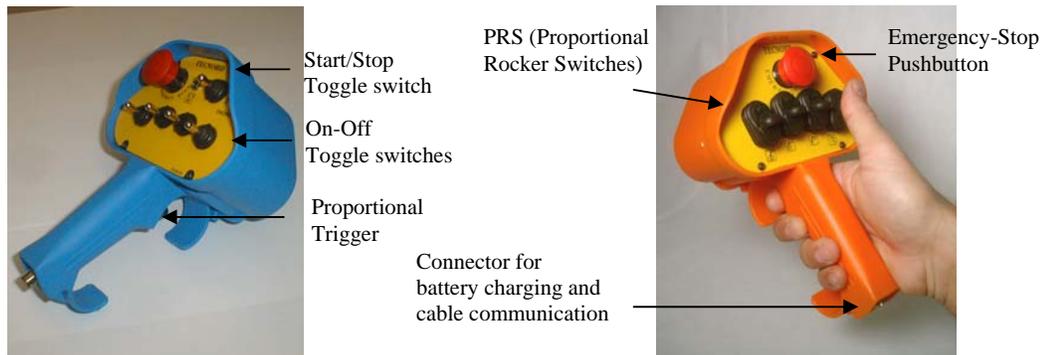
The following parts can be provided as an option:

- SERIAL CABLE (serial/battery charger cable)
- CUSTOMIZED HARNESS
- TRANSMITTER FIXING MAGNET
- PROGRAMMING UNIT WITH DISPLAY

All the above mentioned parts are also available as spare parts.

2.1 Transmitter Unit Control Configurations

RC-DBX transmitters (SHW-TX) can be provided in several control configurations, dependign on customer's requirements. Basically, control configurations differ in the number and type of actuators. The figures below show the available actuators, while the next table outlines the actuators available in the various control configurations.



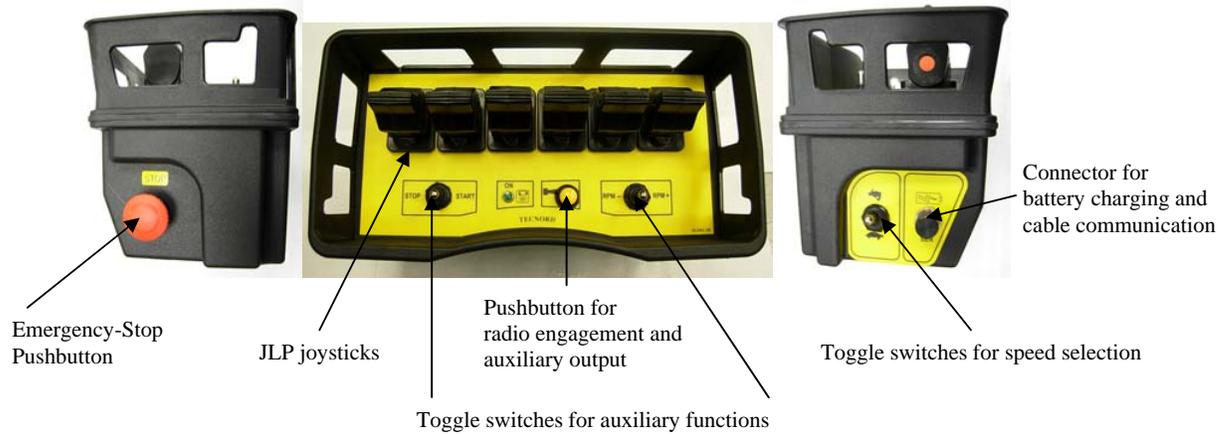
CONTROL CONFIGURATION	On-Off switches	Start/Stop switch	Proportional trigger	PRS	Emergency-Stop
RC-DBD	4 / 5 / 6	Yes	No	-	Yes
RC-DBR	4 / 5 / 6	Yes	Yes	-	Yes
RC-DBM	-	Yes	No	4 / 5 / 6	Yes

RC-PCM transmitters (PCJ-TX) are designed for systems with multiple proportional actuators. The control configuration therefore varies with the number of joysticks provided. Standard equipped actuators are shown in the figure below.



CONTROL CONFIGURATION	JLP Joysticks	Optional Functions	Speed Selection	Pushbutton	Emergency-Stop
RC-PCM	4 / 5 / 6 / 7	Yes	Yes	Yes	Yes

RC-NBM transmitters (NBJ-TX) are designed for systems with multiple proportional actuators. The control configuration therefore varies with the number of joysticks provided. Standard equipped actuators are shown in the figure below.



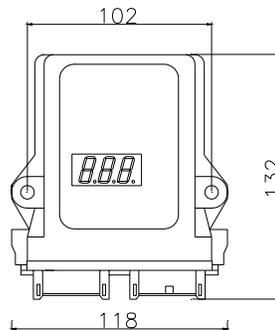
CONTROL CONFIGURATION	JLP Joysticks	Optional Functions	Speed Selection	Pushbutton	Emergency-Stop
RC-NBM	4 / 5 / 6 / 7	Yes	Yes	Yes	Yes

3 INSTALLATION

WARNING !

- Only a qualified and specialized technician should install the receiver of a radio control to the electrical system of a machine (see par.4, Maintenance) who is acquainted with both the electrical circuit of the machine and the radio control technical features.
- During the entire installation phase both the transmitter and the receiver must be turned off.
- All of the regulations on the health of the staff working within the installation area, together with any local regulations in force, and those on fire prevention must be observed.
- TECNORD declines all responsibility, neither does it grant any guarantee whatsoever for any damage caused to things or persons due to the improper or careless use of this equipment or due to the non-observance of any regulation or that, which has been indicated in the operating instructions.

3.1 DBX Receiver Unit sample drawing



3.2 Positioning the receiver

WARNING !

When positioning the receiver, check that it is not being screened by large metallic surfaces.

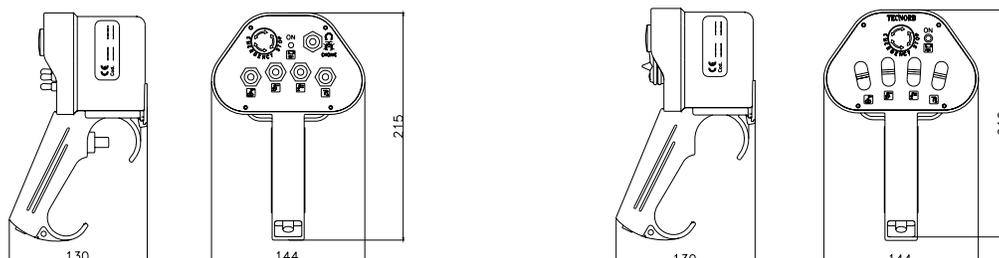
For the Radio Control to operate smoothly, it is necessary that the receiver should be installed in such a position as to allow the maximum reception of radio waves from the antenna. The metallic parts of the machine to be controlled that surround the receiver create a barrier that interferes with reception

In most cases, the receiver can be housed on any side of the machine or, if necessary, for installations on vehicles even inside the glass cabin. It is also necessary to place the receiver where it is accessible and safe to work both for those who carry out the installation of the electrical connections and for those who will do the future maintenance.

Make sure to keep the display visible to the user in order to ease the diagnostics of the equipment during operations.

Should such an installation be performed on board mobile machinery or on a vehicle, then you should attach rubber bumpers. These rubber bumpers will prevent strong vibrations from the machine to the receiver.

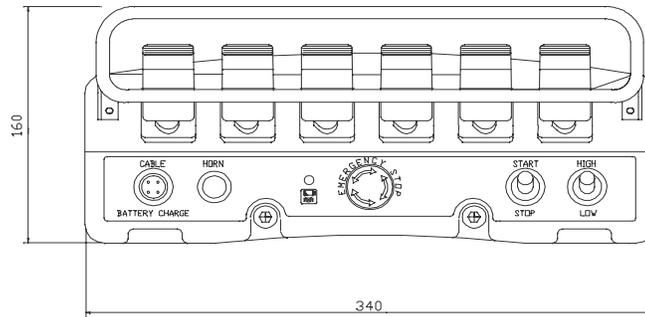
3.3 SHW Transmitter Unit sample drawing



DBD/DBR control configurations

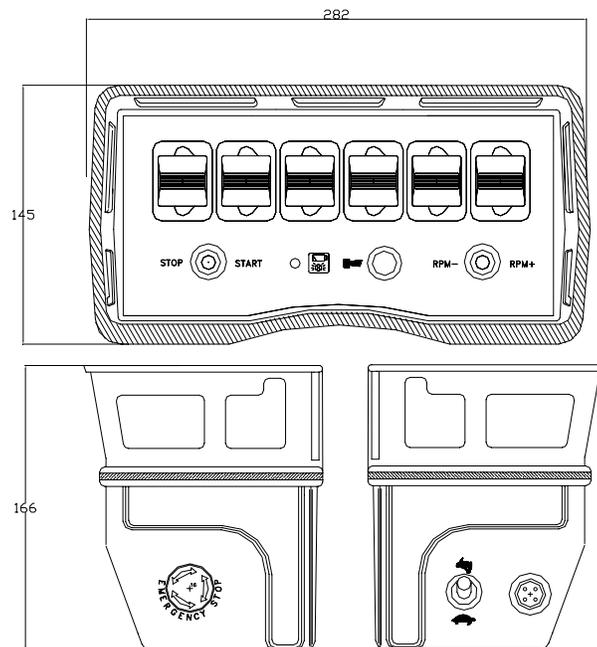
DBM control configuration

3.4 PCJ Transmitter Unit sample drawing



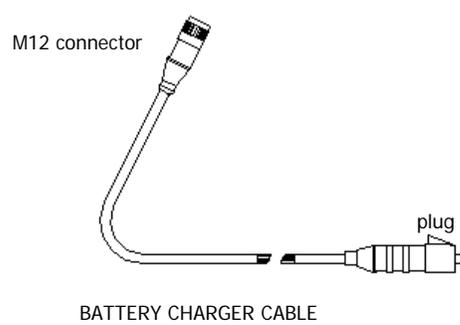
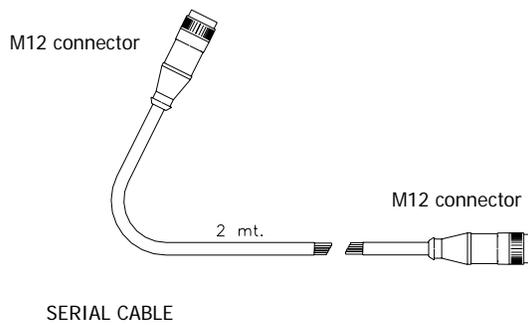
PCM control configuration

3.5 NBJ Transmitter Unit sample drawing



NBM control configuration

3.6 Battery Charger and Serial Cable sample drawings



3.7 Outside electrical connections

Outside electrical connections are:

- Power Supply
- Input / Output connections

For safety reasons it is recommended to install on the controlled machine a supply disconnecting device in order to cut off the receiver's power supply when necessary. This supply disconnecting device should comply with the directive EN60947-3, cat. AC-23B or DC-23B. The following requirements apply to the supply disconnecting device:

- *isolate all live conductors of the electrical equipment from the supply and have one OFF and one ON position only, that shall clearly marked with the "0" and "1" symbols respectively*
- *have a visible gap or a position indicator which cannot indicate OFF until all contacts are actually open*
- *have an external operating handle, which shall be easily accessible to the operator, and must be located between 0,6m and 1,9m above the servicing level. The device must be provided with means permitting it to be locked in the "off" position.*

For safety reasons, a fuse of 10A is included in the DBX-RX receiver's box.

All the connections between the equipment and the power supply must be made with conductors having a diameter of at least 2.5mm.

Each function that is activated on the transmitter unit activates a dedicated output, or a combination of more outputs, on the receiver unit, depending on the configuration of the machine to be operated.

3.8 Declaration of Installation

WARNING !

During the installation phase it is necessary to make sure that:

- the radio remote control and the machine work together according to the regulation currently in force and to the safety characteristics of the machine as supplied by the manufacturer;
- all the functions of the radio remote control, as well as their conformity on the equipped machine have been completely checked and tested; this includes in particular the Emergency Stop function.

TECNORD is not responsible of the remote control's installation; the installer is therefore required to issue the operator a Declaration of Installation that must be kept together with this manual by the operator. A template for the declaration of Installation is shown below.

DECLARATION OF REMOTE CONTROL INSTALLATION	
I, the undersigned _____	
born in _____ State/Province _____ on _____	
legally responsible for the installing Company _____	
with its headquarters in _____	
DECLARE:	
1 – to have installed on _____ on the machine of brand _____	
type _____ serial number _____	
at the Company _____	
located in (street) _____ (Town/City) _____	
a Radio Remote Control System branded TECNORD	
type _____ model _____	
system n° _____	
2 – that the installation has been carried out according to the regulations currently in force for the type of machine being equipped and that all these regulations have been observed;	
3 – that the interface between the machine and the receiver is suitable and has been properly manufactured according to the instructions provided by the manufacturer, and that all the necessary tests have been carried out.	
On this day of _____ in _____	
Signature and stamp of the Installer _____	<div style="border: 1px solid black; width: 150px; height: 50px; margin: 0 auto;"></div>

4 OPERATION

4.1 The radio transmission and servicing system

Tecnord's RC-DBX ,RC-PCM and RC-NBM Radio Control Systems allow for the operating machines to be controlled in general by means of electro-magnetic waves. It is made up of a portable transmitter unit (SHW ,PCJ TX or NBJ-TX) held by the operator and of a receiver unit (DBX-RX) that is usually installed on the machine to be controlled.

Each function originated from several devices or control actuators of the transmitter is transformed into a serial command that is coded and transmitted through a high-frequency carrier. The receiver captures the information output from the transmitter, decodes the messages and sends the controls to the machine by means of electronic power switches controlled by a microprocessor and a dedicated harness.

The information sent from the transmitter is contained in a message commonly named "telegram". This telegram consists of an identifier, a command field and a redundancy field for error control. The identifier, or matching code, contains the identification elements to match the transmitter with its coupled receiver. The command field contains all the information relevant to the commands that the machine should carry out. The error control redundancy fields allow the receiver to discard messages that are found modified by disturbs on the radio link.

As the matching code is unique for each TX/RX pair, each Transmitter can control through radio waves only its coupled Receiver, which is labeled with the same System Number.

4.2 Use of Batteries

Tecnord's Radio Control System is equipped with batteries for operating the Transmitter. Rechargeable NiMH batteries are supplied with the Transmitter unit and guarantee a long operating time.

The working voltage of the transmitter is constantly controlled. Should it fall below a threshold value, the corresponding indication is activated (green led blinking) each time the transmitter is put into operation. From this moment, the transmitter can continue to operate, but it is recommended to recharge the batteries as soon as possible. For additional power-saving, a "PowerSave" mode is implemented (see paragraph 4.8).

Batteries are protected against short -circuit. For additional safety and ease of use, they are located as far as possible from the rest of the electronics in the Transmitter.

4.3 The battery charger and re-chargeable batteries

The RC-DBX-TU transmitter unit is equipped with a battery charger circuit; therefore it is not necessary to remove the batteries for the charging operation, and is possible to operate the machine during the battery charging procedure.

In order to charge the batteries, connect the Transmitter to its DBX-RX receiver unit through the **battery charger cable** supplied with the equipment. As an option, a different **serial cable** can be provided, which allows the charge to be carried out while operating the machine. In order to use the serial cable option, the harness must be provided with an appropriate M12 female connector. The charging phase for a completely discharged battery can last **up to three hours**, and it is continuously controlled by the microprocessor. When the battery charger states that charging is complete, it automatically disconnects, therefore avoiding overcharge phenomena that could reduce batteries life.

WARNING !

Use TECNORD original spare parts only! If not, there is the danger of an explosion. Chemical substances that leak or parts that detach themselves can cause irreparable damage.

4.4 Control Elements

Tecnord manufactures a family of Industrial Radio Controls suitable for just as many applications. Further more, Industrial Radio Controls are designed according to the specific requests of the Customer or the User.

Tecnord's Radio Remote Control Equipment are designed as complete systems for controlling an operating machine's functions. Each Radio Control System can be fitted with many different control elements according to the machine to be controlled, as well as provided with standard controls for its operation, stopping, acoustic warning, start switch, warning led etc.

Push buttons, switches, selectors, joysticks and special control accessories complete the radio control. Their type and number are features of each "control configuration".

Configurations "D", "R": up to 6 toggle-switches with 3 positions (1 stable + 2 temporary) for the function's selection, 1 proportional trigger available for speed control in the "R" configuration

Configuration "M": up to 6 PRS (Proportional Rocker Switches, for DBX) or 7 JLP joysticks (for PCM) for the control of more functions with proportional actuators

For a better diagnosis of the machine's operating status, the DBX-RX receiver is equipped with a display on which is possible to make system information available (see paragraph 8.2).

4.5 Visual Check



WARNING !

Always check the sound condition on the transmitter before operating.

- Are all the safety devices in the correct position and in good condition?
- Are there any broken parts?
- Are all of the rubber protections and the actuator covers sound?
- Are all of the connecting plugs and cables sound?



WARNING !

Never work with a Radio Control which results damaged! Always remove any of the above-mentioned faults before starting to work!

4.6 Safety Control and Start-up of the Radio Control



WARNING !

Important checks on some of the functions mentioned below are required for the first start-up of the Radio Control!

- Verify that the transmitter battery casing on the SHW-TX unit also houses a rechargeable battery and that the battery is connected.
- Release the Emergency Stop Push Button on the Transmitter unit, if pressed. Releasing the Emergency Stop Push Button turns the TX unit on. In RC-PCM or RC-NBM systems it is necessary to engage the radio control with the appropriate pushbutton.
- Now, your Radio Control is ready to work. Activate any function on the transmitter unit and verify whether the machine stops when the same function is released should you release the switch or re-set the proportional actuator to zero.
- Now check that the Emergency Stop function works exactly as described by the manufacturer of the machine by applying the following procedure:
 1. Start any of the functions of the transmitter, verify that the function is activated by the receiver and keep it running
 2. Push the Emergency push button on the transmitter
 3. Verify that the function carried out stops immediately and that no other functions can be then operated from the transmitter
 4. Was the safety control successful and does the Emergency Stop function work perfectly?
 5. Now release all the control elements
 6. Release the Emergency stop push button, your radio control is now ready to operate in total safety



WARNING !

Should any fault or problem be noticed during the initial starting, turn the machine off immediately. Never operate the machine unless the Emergency Stop Button functions properly. Serious danger exists for both people and things from the non-observance of this extremely important regulation. Any operation not conforming to this basic operating rule may lead to the loss of both the operating permit and your warranty.

4.7 Functions operation

Two possible types of electronic control exist that can be operated from the Radio Control, the digital and analog also named ON-OFF and Proportional respectively. The ON-OFF control determines either the activation or deactivation of an output stage within the receiver when the transmitter activates this control. Usually, these are commands that can be sent from push-buttons, switches, selectors or digital joysticks.

The Proportional control is a function determining a variable output in either current or voltage in a way which is directly proportional to the position of an analog actuator on the transmitter, be it a proportional trigger, a proportional rocker switch (PRS), a potentiometric joystick or a simple potentiometer. Tecnord manufactures different types of proportional controls for several models of solenoid valves, servo controls or other devices. The transmission technology remains unchanged, while the proportional output stage of the receiver is designed for the different requirements of the command to be carried out.

4.8 PowerSave Mode and Out-of-service

The Transmitter is powered on when the Emergency Stop Pushbutton is released. In order to reduce power consumption a PowerSave Mode is implemented. When the Transmitter is powered by batteries and no function is activated for five minutes the system goes into a "PowerSave" mode: the led is switched off and the RF module is no longer active. In order to operate it is necessary to press and then release the Emergency Stop Pushbutton.

When the Transmitter detects a low value on the batteries the led blinks indicating that battery charging is required. When the battery level is below the threshold for safe operation the system goes out-of-service: the led is switched off and the RF module is no longer active.



WARNING !

In both PowerSave and Out-of-service modes, the Transmitter is no longer powered on, even if the Emergency Stop Pushbutton is released, due to electronic switches. Anyway, it is always a good practice to keep the Emergency Stop Pushbutton pressed when you're not operating in order to mechanically disconnect the batteries from the circuits.

4.9 Diagnostics

The RC-DBX , RC-PCM ,RC-NBM Radio Control Systems allow diagnostics on both the Transmitter units and the DBX-RX receiver unit. The details on the system's diagnostics can be found in chapter 8.

4.10 Operating problems

Repairs and checks following failure of the Radio Control equipment must be carried out according to the instructions below so that the system maintains all of its original features. In the event of malfunctions, check that the machine provided with Radio Control operates properly with traditional control systems (such as, for example, cable control, fixed panel etc.).

Verify that in the area you are operating in with your Radio Control no other Radio equipment has started working and is operating on the same radio frequency. Also verify that you are operating the transmitter with its own coupled receiver.

If the outputs of the receiver unit are not energized when commands have been transmitted and the machine cannot therefore carry out any operation, then check the state of the receiver's power supply fuse, check the wiring connections to find out if any of the wires is not properly connected or is out of its housing or coupling.

The non-operation of an RC-DBX , RC-PCM , RC-NBM system may depend on either the transmitter or the receiver. The table located in the following paragraph may help in the diagnosis of the most common causes of malfunction.

4.11 Troubleshooting table

Tecnord's Radio Control Systems implement a microprocessor technology in both the Transmitter and Receiver units. Each system is subject to a quality assurance test at the manufacturer's plants before being delivered to the customer. However, should a failure subsequently occur, a swift diagnosis is possible and hence a quick reset of the Radio Control through the technical assistance service.

FAILURE	POSSIBLE CAUSE	ACTION
No reaction of the Transmitter when turned on	No battery pack is connected.	Connect a Tecnord's original battery pack
	Batteries are completely discharged or damaged	Recharge batteries or replace batteries when damaged
The Receiver's display doesn't turn on	Interruption of the receiver's power supply	Turn the main switch on. Verify the connections and the fuses. Measure the voltage input to the receiver unit. Check the fuse inside the enclosure.
No reaction of the Receiver to the activation of any function on the transmitter	The Emergency Stop pushbutton is pressed	Release the Emergency Stop pushbutton to turn the Transmitter on
	The radio control has not been engaged The Transmitter is in PowerSave mode	Engage the radio control using the appropriate pushbutton Press and then release the Emergency Stop pushbutton to resume normal operating mode
	The Transmitter is out of service	Recharge batteries
	(In control configurations with proportional trigger) the proportional trigger has been pressed before activating the on-off function	Release all the actuators, activate first the on-off actuator of the function, and then use the proportional trigger for speed regulation
The function is inhibited by blocks such as limit switches etc. Loss of radio communication		Activate only the functions that are allowed in the current machine's state
		Verify that you are in the Radio Control's operating range Make sure that no other Radio Controls are operating on the same frequency in the same area Make sure that the receiver is not shielded by metal enclosures
Batteries short operating time	Batteries damaged or at the end of life	Replace batteries with Tecnord's original spare parts
Open or short circuit indication on one output	Wiring problems	Verify the connections the involved output



WARNING !

In the event of malfunctions, please check the items outlined in the above table before contacting the Technical Assistance Service.

5 MAINTENANCE

Tecnord's RC-DBX,RC-PCM,RC-NBM Radio Control Systems does not require any special maintenance. However, some precautions are necessary in order to ensure that the equipment is both efficient and safe. Each radio control must be checked at least once a year. The staff in charge of maintenance must check that the receiver is not powered on during the checks and the inspection inside the transmitter.

Dust and other material from the working environment as well as dirt can deposit on the transmitter and receiver units. Remove it so that the buttons, joysticks and actuators in general, including the emergency stop push button, are always clean and therefore in good working order.

Each control unit has been designed so that all that the above causes the least amount of problems possible to the smooth operation of the Radio Control. However, careful periodical maintenance by the user will certainly prolong its life span.

The inner inspection of the transmitter should be carried out only by trained staff in a dry and dump-free place. As well as removing all traces of dirt and drying any condensation with warm air, the checking of the connections of the different wires and terminal boards of interconnections, as well as the dean condition of the electrical contacts of all of the control actuators is also highly recommended.



WARNING!

In the event of the possible oxidation of the electrical contacts, never use any type of anti-oxidant spray or similar product. Instead, contact your service center to immediately replace these parts. These problems can be caused by the particular environmental conditions in which the radio control operates. Using chemical products on the actuators could cause irreparable damage to the mechanical and electronic parts.

The duration and the capacity of the batteries depend on many elements such as the operating temperature, the charging and discharging cycles, but basically on how often the radio control is used. It is highly recommended to always use the battery charge until the "low battery" indication aactivates, and to replace it at least every 2 years.

Besides the regular checks on the interconnections and the firm tightening of the terminal boards for the output controls, it is recommended to check that the seal of the transmitter unit cover is in good condition and that it is watertight. After 2/3 years of operation, it is suggested to check the smooth operation of the electronic and electro-mechanical parts, their response to commands and their drop out speed. Special layers of resin-based insulating paint and with anti-oxidant properties protect the electronic parts of the Radio Control system; hence they do not require any maintenance. It is, however, necessary to check the various interconnections between the different modules.

6 DISPOSAL



WARNING !

Avoid environmental pollution.

Electrical devices and their parts are dangerous waste. This specially applies to batteries and rechargeable accumulators. Engage a specialized company for their disposal.

7 TECHNICAL DATA

7.1 *Transmitter (SHW-TX, PCJ-TX, NBJ-TX)*

	<i>USA/CANADA version</i>	<i>EUROPE version</i>
Working frequency:	902 ÷ 928 MHz	869.7 ÷ 870 MHz
Transmission Type:	FHSS (Frequency Hopping Spread Spectrum)	Single Frequency FSK
RF output power:	< 200 mW e.r.p.	< 5 mW e.r.p.
Antenna:	Fixed internal	
Power Supply:	4.8 V _{DC}	
Battery:	Rechargeable (NiMH)	
Operating time:	8 - 10 hours	
Battery charger:	Built-in (into the RC-DBX-TU) battery charge through the service cable (standard supply)	
Simultaneous commands available:	All	
Operating range:	about 50 m	about 30 m
Diagnostics:	buzzer, green led	
Housing material:	Fiber enforced Polycarbonate	
Weight:	< 0,7 kg (with batteries)	
Environmental protection:	IP 65	

7.2 *Receiver (DBX-RX)*

	<i>USA/CANADA version</i>	<i>EUROPE version</i>
Working frequency:	902 ÷ 928 MHz	869.7 ÷ 870 MHz
Sensitivity:	- 100 dBm	
Antenna:	Fixed internal	
Power Supply:	From 8,5 to 30 V _{DC}	
Output power:	On/Off outputs: Max 3.5A Proportional outputs: Max 1.8A Voltage analog outputs: choice between 0 – 5V, 0 – 20mA	
Housing material:	Thermoplastic	
Connectors	Deutsch	
Weight:	< 0.4 kg	
Environmental protection:	IP 65	
Response time for passive emergency:	< 250 ms	

7.3 *Communication Protocol*

Transmission speed:	9600 bit/s
Error check:	32-bit CRC
Auxiliary channel:	RS-485, available using the standard supplied service cable

8 SYSTEM DIAGNOSTICS AND CONFIGURATION

8.1 Transmitter's Diagnostics

Diagnostic on the Transmitter unit is carried out by means of:

- a buzzer
- a green led

8.1.1 Buzzer

Indications in Radio Mode:

The buzzer provides the following indications:

- one short beep when the Transmitter is powered on, i.e. when the Emergency Stop Pushbutton is released;
- four short beeps when the Transmitter enters PowerSave mode or goes out of service due to a low battery voltage.

Indications in Cable Mode:

The buzzer provides the following indications:

- one short beep when the Transmitter is powered on, i.e. when the Battery Charger Cable is connected to the unit.

8.1.2 Green Led

Indications in Radio Mode:

The led provides the following indications:

- led on while the Transmitter is powered on, i.e. when the Emergency Stop Pushbutton is released, and the battery level is correct for safe operation;
- led continuously blinking while the Transmitter is powered on, i.e. when the Emergency Stop Pushbutton is released, and the battery level is low;
- led off while the Transmitter is in PowerSave mode or out of service because of an insufficient battery level, or when the unit is powered off, i.e. when the Emergency Stop Pushbutton is pressed.

Indications in Cable Mode:

The led provides the following indications:

- led intermittently blinking (two blinks followed by a pause) indicates that the battery charger is active;
- led on indicates that the Transmitter is powered on (i.e. the cable has been connected) and is ready for operation; during battery charging, it indicates that a function is active;
- led off indicates that the Transmitter is not charging the battery and the emergency pushbutton is pressed.

Note:

When the cable is connected the Transmitter performs some battery checks for about 3 seconds. After that time battery charging is automatically started when no faults are detected.

8.2 Receiver's Diagnostics

8.2.1 Display Menus

The three-digits, seven segments display shows the operating state of the DBX-RX Receiver; the visualization is organized in six menus:

- Normal Display Menu
- Calibration Menu
- System Menu
- Digital Inputs Display Menu (only in RC-DBD/DBR systems)
- Current Display Menu (only in RC-DBD/DBR systems)
- Remote Control Unit Display Menu (only in RC-DBD/DBR systems)

The Normal Display Menu is the menu for the normal operating mode and is selected by default when the Receiver is being powered on; from this menu it is possible to access any other menu (with the exception of the System Menu).

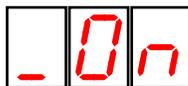
Only the two Pushbuttons integrated in the receiver's electronics allow to access the System Menu; it is recommended that the System Menu be accessed only by personnel trained for the Technical Assistance Service.

8.2.2 Normal Display Menu

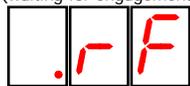
This is the menu for the normal operating mode, and is selected by default when the Receiver is powered on. The following indications are displayed:

Normal operation:

No active operation
(waiting for RF signal)



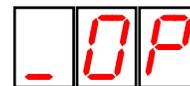
No active operation
(RF signal detected)
(waiting for engagement)



No active operation
(RF signal detected)
(radio engaged)



_OP Operation in progress



Alarm indications (only in DBD / DBR systems):

Oxx Open circuit detected on valve xx when trying to start a movement (see the table with all the alarm codes)



Example: open circuit alarm on valve 3B:



Cxx Short circuit detected on valve xx when trying to start a movement (see the table with all the alarm codes).



Example: short circuit alarm on valve 1A:



The following table shows all the displayed alarm codes.

<i>Display</i>	<i>Alarm type</i>	<i>Valve with active alarm</i>	<i>Display</i>	<i>Alarm type</i>	<i>Valve with active alarm</i>
O1A	open circuit	EV on/off 1A	C1A	short circuit	EV on/off 1A
O1b	open circuit	EV on/off 1b	C1b	short circuit	EV on/off 1b
O2A	open circuit	EV on/off 2A	C2A	short circuit	EV on/off 2A
O2b	open circuit	EV on/off 2b	C2b	short circuit	EV on/off 2b
O3A	open circuit	EV on/off 3A	C3A	short circuit	EV on/off 3A
O3b	open circuit	EV on/off 3b	C3b	short circuit	EV on/off 3b
O4A	open circuit	EV on/off 4A	C4A	short circuit	EV on/off 4A
O4b	open circuit	EV on/off 4b	C4b	short circuit	EV on/off 4b
O5A	open circuit	EV on/off 5A	C5A	short circuit	EV on/off 5A
O5b	open circuit	EV on/off 5b	C5b	short circuit	EV on/off 5b
O_r	open circuit	VR (proportional)	C_r	short circuit	VR (proportional)

8.2.3 Digital Inputs Display Menu

This paragraph is applicable only to systems that implement digital inputs (e.g. limit switches).

This menu is accessed from the Normal Display Menu with the following procedure: push the proportional trigger to its maximum level, then activate the 1A (first actuator from the left towards up) and 3B (third selector from the left towards down) functions simultaneously for at least 5 seconds.

In this menu the states of the IN0 and IN1 inputs are displayed cyclically, with a 2.5s interval; each digital input can be in one of the following states:

- O open
- C closed

Example: indication of the state "IN1 open"



Example: indication of the state "IN0 closed"



The following table shows all the displayed codes:

<i>Displayed code for Microswitch open</i>	<i>Displayed code for Microswitch closed</i>	<i>Displayed Digital Input</i>
0_O	0_C	IN0
1_O	1_C	IN1

When no operation is activated the Receiver automatically switches to the Normal Display Menu after 60s, otherwise a new power-on is required in order to get out of this menu.

8.2.4 Current Display Menu

This paragraph is applicable only to systems that implement a proportional trigger.

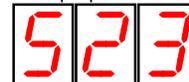
This menu is accessed from the Normal Display Menu with the following procedure: push the proportional trigger to its maximum level, then activate the 1A (first actuator from the left towards up) and 4B (fourth actuator from the left towards down) movements simultaneously for at least 5 seconds.

In this menu, when no operation is active the indication "Cur" is displayed. When a movement is active the value of the current (in mA) that is set for the proportional valve is displayed.

Example: indication without any active movement



Example: indication with an active movement and with 523mA set for the proportional valve



When no operation is activated the Receiver automatically switches to the Normal Display Menu after 60s, otherwise a new power-on is required in order to get out of this menu.

8.2.5 Remote Control Unit Display Menu

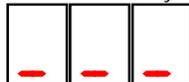
This menu is accessed from the Normal Display Menu with the following procedure: push the proportional trigger to its maximum level, then activate the 1A (first actuator from the left towards up) and 2B (second actuator from the left towards down) movements simultaneously for at least 5 seconds.

In this menu, when no operation is active the indication " _ _ " is displayed. When a movement is active the state of the contact that activated the movement in the SHW-TX Transmitter is displayed. For each of the contacts the following state is displayed:

C closed

In case of a multiple command (two or more movements activated simultaneously) only the state of one of the active commands is displayed, following an internal priority scheme.

Example: indication without any active function



Example: indication when the contact 1A is closed on the SHW-TX



The following table shows all the displayed codes:

<i>Display</i>	<i>Displayed Status</i>
C1A	closed contact 1A
C1b	closed contact 1B
C2A	closed contact 2A
C2b	closed contact 2B
C3A	closed contact 3A
C3b	closed contact 3B
C4A	closed contact 4A
C4b	closed contact 4B
C5A	closed contact 5A
C5b	closed contact 5B
CEA	closed Engine Start
CEb	closed Engine Stop

When no operation is activated the Receiver automatically switches to the Normal Display Menu after 60s, otherwise a new power-on is required in order to get out of this menu.

8.3 Calibration Menu

This paragraph is applicable only to systems that implement a proportional current output. The calibration of the parameters of the proportional output is carried out using the two Pushbuttons (Blue Key and Yellow Key) integrated in the receiver's electronics, shown in the figure below.



DBX-RX RECEIVER WITH TWO PUSHBUTTONS

8.3.1 Calibration parameters for DBR systems

Instructions for the Calibration Procedure:

1. Keep the Receiver's electronics outside its enclosure in order to access the two pushbuttons: Blue Key (B-KEY) and Yellow Key (Y-KEY).
2. Press simultaneously the Blue and Yellow keys for at least three seconds, until the dot on the right digit turns on and the value of the configured minimum current I_{MIN} (in mA) is displayed. Release the keys in order to go on with the calibration procedure.
3. The menu allows four calibrations, in order: minimum current, maximum current, acceleration time ramp, deceleration time ramp. **In order to switch from one calibration to the next, press simultaneously the Blue and Yellow keys.**

In the calibration menu the display dots give information about which parameter is currently being configured in the following way:

<p>Setup of the minimum current I_{MIN} (in mA)</p>	<p>Example: "$I_{MIN} = 410$".</p>
<p>Setup of the maximum current I_{MAX} (in mA)</p>	<p>Example: "$I_{MAX} = 610$".</p>
<p>Setup of the acceleration time ramp (from 1 to 100 steps of 50ms each)</p>	<p>Example: "acceleration time ramp 500ms". (10 x 50ms = 500ms)</p>
<p>Setup of the deceleration time ramp (from 1 to 100 steps of 50ms each)</p>	<p>Example: "deceleration time ramp 500ms". (10 x 50ms = 500ms)</p>

In order to change the configured value it is necessary to activate a movement and operate with the Blue and Yellow keys in the following way:

- press the B-KEY to increase the configured value of one step (fine calibration); keeping the B-KEY pressed causes a rapid increase of the configured value (coarse calibration)
- press the Y-KEY to decrease the configured value of one step (fine calibration); keeping the Y-KEY pressed causes a rapid decrease of the configured value (coarse calibration)

When the movement is deactivated, the new values are stored in the non-volatile memory of the DBX-RX Receiver.

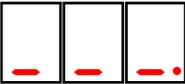
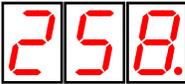
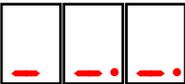
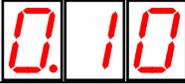
The only way to exit from this menu is a new power-on of the Receiver (i.e. disconnecting the power supply from the receiver).

8.3.2 Calibration parameters for DBM / PCM / NBM systems

Instructions for the Calibration Procedure:

1. Keep the Receiver's electronics outside its enclosure in order to access the two pushbuttons: Blue Key (B-KEY) and Yellow Key (Y-KEY).
2. Press simultaneously the Blue and Yellow keys for at least three seconds, until the dot on the display's right digit turns on. When only one function is active, the display shows the current value of the minimum voltage for the active function, otherwise three dashes are displayed. Release the keys in order to go on with the calibration procedure.
3. The menu allows four calibrations, in order: minimum voltage, maximum voltage, acceleration time ramp, deceleration time ramp. Different values can be assigned to each parameter for every semi-function: just keep the semi-function active and adjust the parameter's value with the keys. **In order to switch from one calibration parameters to the next, press simultaneously the Blue and Yellow keys.**

In the calibration menu the display dots give information about which parameter is currently being configured in the following way:

Setup of the minimum voltage V_{MIN} 	Example: " $V_{MIN} = 2.58V$ ". 	In order to provide a better understanding of the display, all the voltage values related to the "B" semi-functions are reverted with respect to the real value of the output. The real output voltage is: $5V - (\text{displayed value})$. With this trick the operator sees a value that increases when he is increasing the minimum speed of the function. E.g. 258 corresponde to a V_{min} of $5 - 2.58 = 2.42V$
Setup of the maximum voltage V_{MAX} 	Example: " $V_{MAX} = 4.10V$ ". 	In order to provide a better understanding of the display, all the voltage values related to the "B" semi-functions are reverted with respect to the real value of the output. The real output voltage is: $5V - (\text{displayed value})$. With this trick the operator sees a value that increases when he is increasing the maximum speed of the function. E.g. 410 corresponde to a V_{min} of $5 - 4.1 = 0.9V$
Setup of the acceleration time ramp (from 1 to 100 steps of 50ms each) 	Example: "acceleration time ramp 500ms". (10 x 50ms = 500ms) 	
Setup of the deceleration time ramp (from 1 to 100 steps of 50ms each) 	Example: "deceleration time ramp 500ms". (10 x 50ms = 500ms) 	

In order to change the configured value it is necessary to activate a movement and operate with the Blue and Yellow keys in the following way:

- press the B-KEY to increase the configured value of one step (fine calibration); keeping the B-KEY pressed causes a rapid increase of the configured value (coarse calibration)
- press the Y-KEY to decrease the configured value of one step (fine calibration); keeping the Y-KEY pressed causes a rapid decrease of the configured value (coarse calibration)

When the movement is deactivated, the new values are stored in the non-volatile memory of the Receiver.

The only way to exit from this menu is a new power-on of the Receiver (i.e. disconnecting the power supply from the receiver).

RC-PCM systems allow to select between two speed sets (normal and reduced working speed), allowing to independently adjust each parameter of every semi-function in every single speed set. Just select in the Transmitter the working speed set, activate the function and proceed as described above.

Zero Voltage Adjustment

A special procedure allows to adjust the Zero Voltage, i.e. the voltage that is output when the PRS or JLP joysticks are in their zero position. This fine adjustment is usually not necessary because the dead band of the controlled equipment allows small differences between the ideal voltage and the real output signal in the zero position. Anyway it is possible to set a different zero output voltage for every function with the following procedure:

1. Keep the Receiver electronics outside its enclosure in order to access the two pushbuttons: Blue Key (B-KEY) and Yellow Key (Y-KEY).
2. Press simultaneously the Blue and Yellow keys for **about ten seconds**, then bypassing the calibration menu, until the dot on the display's right digit starts flashing. The current value of the zero voltage for function 1 is displayed.
3. The menu allows to set the zero voltage in sequence for all the implemented functions. **In order to switch from one function to the next, press simultaneously the Blue and Yellow keys.**

In the calibration menu the display dots give information about which parameter is currently being configured in the following way:

Example: $V_{ZERO}(F1) = 2.51V$ (dot blinking)	Example: $V_{ZERO}(F2) = 2.51V$ (dot blinking)
	
Example: $V_{ZERO}(F3) = 2.51V$ (dot blinking)	Example: $V_{ZERO}(F4) = 2.51V$ (dot blinking)
	
Example: $V_{ZERO}(F5) = 2.51V$ (dot blinking)	Example: $V_{ZERO}(F6) = 2.51V$ (dot blinking)
	
Example: $V_{ZERO}(F7) = 2.51V$ (dot blinking)	
	

8.4 System Menu (for trained staff only)

The System Menu allows basic configurations of the RC-DBX , RC-PCM and RC-NBM systems; depending on the system, the configuration process involves different steps, which are organized as submenus.

For RC-DBD/DBR systems the sequence of submenus is:

1. Proportional Trigger Acquisition (only useful for DBR, only available with the Service Cable connected).
2. Optional Function Setup.
3. System Type Setup

For RC-DBM/PCM/NBM systems the sequence of submenus is:

1. EV9 (venting) safety valve mode of operation.
2. EV49 (safety valve) mode of operation.
3. Optional Function Setup.
4. Output Range Setup

Each of the these procedures is outlined in the following paragraphs.

Instructions for the system menu setup:

1. Disconnect the power supply from the receiver unit.
2. Keep the Receiver's electronics outside its enclosure in order to access the two pushbuttons: Blue Key (B-KEY) and Yellow Key (Y-KEY).
3. **Keeping both pushbuttons (B-KEY and Y-KEY) pressed**, power the receiver on. After the initialization phase, the unit enters the System Menu.
4. Release the B_KEY and the Y_KEY.
5. Keep the B_KEY and the Y_KEY pressed for about 5 seconds until the DBX-RX switches to the next submenu, then release both keys.
6. Repeat step 5 until you reach the submenu where you need to operate.
7. In order to switch from one Setting to the next, press one of the pushbuttons: the B-KEY scrolls forwards, the Y-KEY scrolls backwards. In order to acquire the proportional trigger, act as described in paragraph 8.4.1.

When the procedure is completed, turn the power supply off in order to end the System Configuration, or press both B-KEY and Y-KEY simultaneously for about 5 seconds in order to switch to the next submenu.

Troubleshooting

When, after power-on, the display of the DBX-RX shows the indication "_On", the unit has not entered the System Menu. Power the Receiver off and repeat the procedure keeping both keys pressed until the unit has entered the System Menu.

8.4.1 Proportional Trigger Acquisition

This paragraph is applicable only to systems that implement a proportional trigger. Connect the Transmitter to the Receiver through the service cable in order to carry out the proportional trigger's acquisition.

The Proportional Trigger acquisition is necessary only when the Transmitter unit has been replaced. This procedure ensures that the proportional parameters previously stored in the receiver's memory are maintained.

When entering the Proportional Trigger Acquisition submenu, a code is displayed, which represents the reading of the proportional trigger, and the receiver is ready for the self-calibration procedure. follow these steps:

1. Activate a movement: the receiver will not activate any of the outputs, but it will start the self-calibration acquiring the proportional trigger's reading.
2. Keeping the movement active, push the proportional trigger to its maximum value and release it several times; during this phase the displayed code varies together with the trigger's movements.
3. Release the proportional trigger and deactivate the movement; the receiver stores the trigger's characteristics in its non-volatile memory.

Troubleshooting

When, after having completed steps 1 to 4, the display shows the indication "**Ad.0**", the DBX-RX is not receiving any calibration message from the Transmitter:

- Check that the two units are connected properly through the Service Cable.

When, after having completed steps 1 to 4, the display shows the indication "**000**", the RC-DBX-RU is not receiving any calibration value for the proportional trigger:

- Check that the Emergency Stop Pushbutton is released.

8.4.2 Optional Function Setup

This paragraph is applicable only to systems that implement the optional function OPT1/OPT2. This function is configurable in one of the following operating modes:

Setting	Value displayed	DESCRIPTION
ON-OFF	F_0	OPT1 and OPT2 are standard on-off outputs (EVR and EV9 are not activated)
LATCHING 1	F_1	One latching function: the OPT1 remote switch toggles the OPT1 output on and off OPT2 is a standard on-off output
LATCHING 2	F_2	Two latching functions: the OPT1 remote switch toggles the OPT1 output on and off, the OPT2 remote switch toggles the OPT2 output on and off
LATCHING 3	F_3	One latching function: the OPT1 remote switch toggles the OPT1 output on, the OPT2 remote switch toggles the OPT1 output off
PWM (only RC-DBR)	F_4	OPT1/OPT2 is a PWM function (EVR and EV9 are activated)

8.4.3 System Type Setup

This parameter specifies whether the system has or not a PWM output (i.e. it is an RC-DBD or RC-DBR system). It is configurable with one of the following values:

Setting	Value displayed	DESCRIPTION
DBD	S_0	On-off system (EVR and EV9 are neither activated nor considered in diagnostics)
DBR	S_1	PWM system (EVR and EV9 outputs are activated, diagnostics on EVR is active)

8.4.4 EV9 Mode of Operation Setup

This parameter specifies whether the safety valve labeled EV9 depends on the Emergency Stop or on the Function activation. It is configurable with one of the following values:

Setting	Value displayed	DESCRIPTION
LEVER	9_L	EV9 output is activated when at least one function is active
E-STOP	9_E	EV9 output is activated when the E-Stop is released and safe communication takes place

8.4.5 EV49 Mode of Operation Setup

This parameter specifies whether the safety valve labeled EV49 depends on the Emergency Stop or on the Function activation. It is configurable with one of the following values:

Setting	Value displayed	DESCRIPTION
LEVER	49L	EV49 output is activated when at least one function is active
E-STOP	49E	EV49 output is activated when the E-Stop is released and safe communication takes place

8.4.6 Analog Voltage Output Range Setup

This parameter specifies which kind of system is driven by the analog voltage outputs of an RC-DBM, RC-PCM or RC-NBM system. Its value affects the voltage values displayed during parameters adjustments and tells the system if the output voltage must be an absolute value or ratiometric with respect to the measured battery voltage. It is configurable with one of the following values:

Setting	Value displayed	DESCRIPTION
ML4	U_0	MLT FD4 system. Reference values are 0,9V – 2,5V – 4,1V (absolute)
ML2	U_1	MLT L2 system. Reference values are 2V – 4V – 6V (absolute)
DNF12	U_2	12V DNF system. Reference values are 3V – 6V – 9V (ratiometric)
DNF24	U_3	24V DNF system. Reference values are 6V – 12V – 18V (ratiometric)
SMD	U_4	SMD system. Reference values are 2V – 4V – 6V (absolute)

WARNINGS (as required by FCC part 15 and IC RSS-210):

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) This device must accept any interference, including interference that may cause undesired operation.

This equipment has been approved for mobile applications where the equipment should be used at distances greater than 20cm from the human body (with the exception of hands, wrists, feet and ankles). Operation at distances less than 20cm is strictly prohibited.

In any case the message coding and elaboration ensures that no outputs are activated due to radio interferences. Outputs are activated only when the corresponding messages are received and interpreted as correct.